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Operational Noise Data for OH-58D Army Helicopters

by
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FOREWORD

This research was conducted for the Army Materiel Command (AMC), Army Helicopter Improvement Program (AHIP) at St. Louis, MO, under Reimbursable Orders DODA 73-9-P6005 dated June 1989 and 73-8-P6008 dated October 1990. The technical monitor was Ken Schaedler (PM AHIP).

The work was conducted by the Acoustics Team of the Environmental Division (EN) of the U.S. Army Construction Engineering Research Laboratory (USACERL). Dr. Paul D. Schomer is Acoustics Team Leader. Dr. Edward W. Novak is Acting Chief of USACERL-EN. The USACERL technical editor was Gloria J. Wienke, Information Management Office.

LTC E.J. Grabert, Jr. is Acting Commander of USACERL, and Dr. L.R. Shaffer is Director.

CONTENTS

TABLES

FIGURES

OPERATIONAL NOISE DATA FOR OH-58D ARMY HELICOPTERS

1 INTRODUCTION

Background

Research at the U.S. Army Construction Engineering Research Laboratory (USACERL) on Army noise problems has centered on predicting and assessing the effect of noise on and adjacent to Army facilities. Blasts, vehicles, fixed sources, and rotary-winged aircraft have been identified as the major noise problems. With the increased pressure of residential development, the Army has instituted the Installation Compatible Use Zone (ICUZ) program.[1] Like the Department of Defense's (DOD) *Construction Criteria* manual and *Air Installations Compatible Use Zone* (AICUZ) program, the ICUZ program defines land uses compatible with various noise levels and establishes a policy for achieving such uses.[2] These documents describe three noise zones that restrict land use in varying degrees to ensure compatibility with military operations. The ICUZ program stresses the Army unique noise sources such as blasts and rotary-winged aircraft.

The ICUZ/AICUZ programs use source emission data with sound propagation and human/community response data to generate noise zone maps. The OH-58D helicopters were added to the Army's inventory after the previous investigations[3]; their noise emission data are required by the Army for ICUZ and environmental assessment.

Objectives

The objectives of this study were to gather "close-in" (within 500 ft[*]) noise source emission data on the OH-58D helicopter, to normalize this source spectra to 250 ft for use in noise maps, and to develop sound equivalent level (SEL) versus distance curves for comparison with other helicopter data.

Approach

Previous research studied the repeatability of rotary winged aircraft source emissions and presented recommendations for statistical validity and a revised microphone layout for data gathering.[4] That revised

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[1] Army Regulation (AR) 200-1, *Environmental Protection and Enhancement*, Chapter 7 (U.S. Army Corps of Engineers [USACE], 15 June 1982).

[2] DOD 4270.1-M, *Construction Criteria* (Department of Defense [DOD], 1972); DOD Instruction 4165-57, *Air Installations Compatible Use Zones* (DOD, 1973).

[3] P.D. Schomer, Aaron J. Averbuch, and Richard Raspet, *Operational Noise Data for the UH60A and CH47C Army Helicopters*, Technical Report N-131/ADA118796 (U.S. Army Construction Engineering Research Laboratory [USACERL], June 1982); P.D. Schomer, et. al., *Operational Noise Data for CH-47D and AH-64 Army Helicopters*, Technical Report N-88/04/ADA191059 (USACERL, June 1982).

[*] A metric conversion table is provided on page 29.

[4] B. Homans, L. Little, and P. Schomer, *Rotary Wing Aircraft Operational Noise Data*, Technical Report N-38/ADA051999 (USACERL, 1978); P.D. Schomer, *Rotary-Winged Aircraft Noise Measurements: Analysis of Variations and Proposed Measurement Standards*, Technical Report N-184/ADA146207 (USACERL, September 1984).

layout and recommended methodology were used to measure noise emissions of OH-58D helicopters at High Bluff Field, Fort Rucker, AL.

Mode of Technology Transfer

The data developed for the OH-58D helicopter will be entered in the Integrated Noise Contour System data base and will be immediately available for use by the Army Materiel Command, U.S. Army Environmental Hygiene Agency, and other DOD organizations.

2 DATA COLLECTION

Helicopter Operations

The OH-58D noise measurements, recorded at Fort Rucker, AL, were based on the dynamic operations listed in Tables 1 and 2. In all, 8 sets of up to 31 operations were measured and recorded over 4 days of testing (26 and 27 October and 14 and 15 November 1989). Cameras with graduated poles as references were used to determine the position of the helicopter (accurate to ± 1 ft) as it flew over the center of the microphone array. Figure 1 shows the layout at Fort Rucker, AL.

The helicopter performed level flyovers (LFOs) at 40 knots, 70 knots, 100 knots, and maximum speed at 300 ft above ground level (AGL) and at 70 knots and 100 knots at 1000 ft AGL. The ground at the center point of the circular microphone array was designated as 0 ft AGL. In-ground-effect (IGE) hovers and out-of-ground-effect (OGE) hovers and zero-pitch engine idle operations were also executed above the center point of the microphones.

The pilots were instructed to maintain straight, level, steady flight for at least 1.5 nautical miles (nmi) away from the measurement microphones. All teardrop turns, other ancillary maneuvers, and preparations for actual dynamic operation were performed beyond 1.5 nmi. Maneuvering at this distance allowed the pilot to stabilize the aircraft and provided enough time and distance for 10-decibel (dB) down-points to be measured and recorded on magnetic tape when the operation was level flyovers. The first 10-dB down-point is the first time the A-weighted signal increases to within 10 dB of the maximum A-weighted sound level of the entire flyover. The last 10-dB down-point is the last time the A-weighted signal decreases minus 10 dB below the maximum A-weighted sound level. Landings began at 300 ft AGL with the aircraft facing into the wind and terminated at the center of the microphone array.

Static operations consisted of zero-pitch engine idle, IGE and OGE hovers. These measurements were performed over a grassy area at the center of the microphone array. IGEs were performed with the aircraft at a stabilized position between 1 and 5 ft above the ground. OGEs were performed at 1.5 rotor diameters AGL.

The pilot of each flight logged all helicopter operations information. Typical log entries are shown in Appendix A.

Microphone Placement

The layout for the six microphones is shown in Figure 1. This arrangement allows adjustment of the helicopter flight path depending on the wind direction. The microphone elements were 4 ft high and 500 ft from the center of the circle at 60-degree intervals so that two microphones were directly underneath the flight path and the other four were at equal distances (500 ft•sin 60 degrees = 433 ft) to either side of the flight path. The slant (closest approach) distance from the helicopter operating at 300 ft AGL, to the microphone is 527 ft. To better compare with previous measurements, it would have been desirable to arrange the sideline microphones at a slant distance 500 ft away from the flight path; however, the requisite 462 ft diameter array would have placed some microphones above hard surfaces at the Fort Rucker site, hence the choice of the 500 ft diameter array.

Table 1

Operations for Data Sets 1 Through 4

Run Number	Operation	Altitude (ft)	Speed(knots)
1	Takeoff (TKF)	300	40
2 & 3	Level flyover (LFO)	300	100
4 & 5	LFO	300	40
6 & 7	LFO	300	70
8 & 9	LFO	300	Max
10 & 11	LFO	1000	70
12 & 13	LFO	300	100
14	Landing (LND)	300	40
15	Idle	0	0
16	IGE	2	0
17	OGE	50	0
18	TKF	300	40
19 & 20	LFO	300	40
21 & 22	LFO	300	Max
23 & 24	LFO	1000	70
25 & 26	LFO	300	100
27 & 28	LFO	300	70
29 & 30	LFO	300	100
31	LND	300	40

Measurement Instrumentation

The acoustical instrumentation consisted of six B&K 4149 quartz-coated, 1/2-in. microphones on B&K 4921 outdoor microphone systems with windscreens. The sound pressure from each operation was recorded through the microphones onto Digital Audio Tape (DAT) using Panasonic SV-250 recorders. The six microphones were connected above ground, using electronically balanced and shielded twisted pair cabling, to a truck modified to be a mobile field acoustics laboratory.

Ground Tracking System

Cameras were used to mark the position of the aircraft when it flew over the middle of the microphone array. These cameras focused on uniformly graduated poles mounted in the line of sight to the center of the array and elevated to frame the aircraft over the array center at 300 ft AGL. Position information was determined by examining the photographs, which showed the aircraft from the two camera positions simultaneously. Three camera locations were chosen such that two of three cameras always framed a clear picture of the helicopter without interference from the sun. Use of the radar

Table 2

Operations for Data Sets 5 Through 8

Run Number	Operation	Altitude	Speed(knots)
1	TKF	300	40
2 & 3	LFO	300	70
4 & 5	LFO	300	100
6 & 7	LFO	300	Max
8 & 9	LFO	1000	100
10 & 11	LFO	300	40
12 & 13	LFO	300	70
14	LND	300	40
15	IDLE	0	0
16	IGE	2	0
17	OGE	50	0
18	TKF	300	40
19 & 20	LFO	300	70
21 & 22	LFO	300	Max
23 & 24	LFO	1000	100
25 & 26	LFO	300	100
27 & 28	LFO	300	40
29 & 30	LFO	300	70
31	LND	300	40

altimeter in this aircraft significantly improved the stability and accuracy of level flight in comparison to previous tests with aircraft not so equipped. For this reason, no additional height measurements were taken.

Calibration

At the beginning of each tape, the 1000-Hz electrostatic actuator built into the B&K 4921 microphone systems was used to record a known level on the tape. The electrostatic actuators were tested with B&K 4220, 124-dB pistonphones before and after the entire measurement program. (Calibration of the electrostatic actuator with the B&K 4220 allows one to establish an absolute calibration value for each actuator.) Calibration was checked at the end of each measurement period.

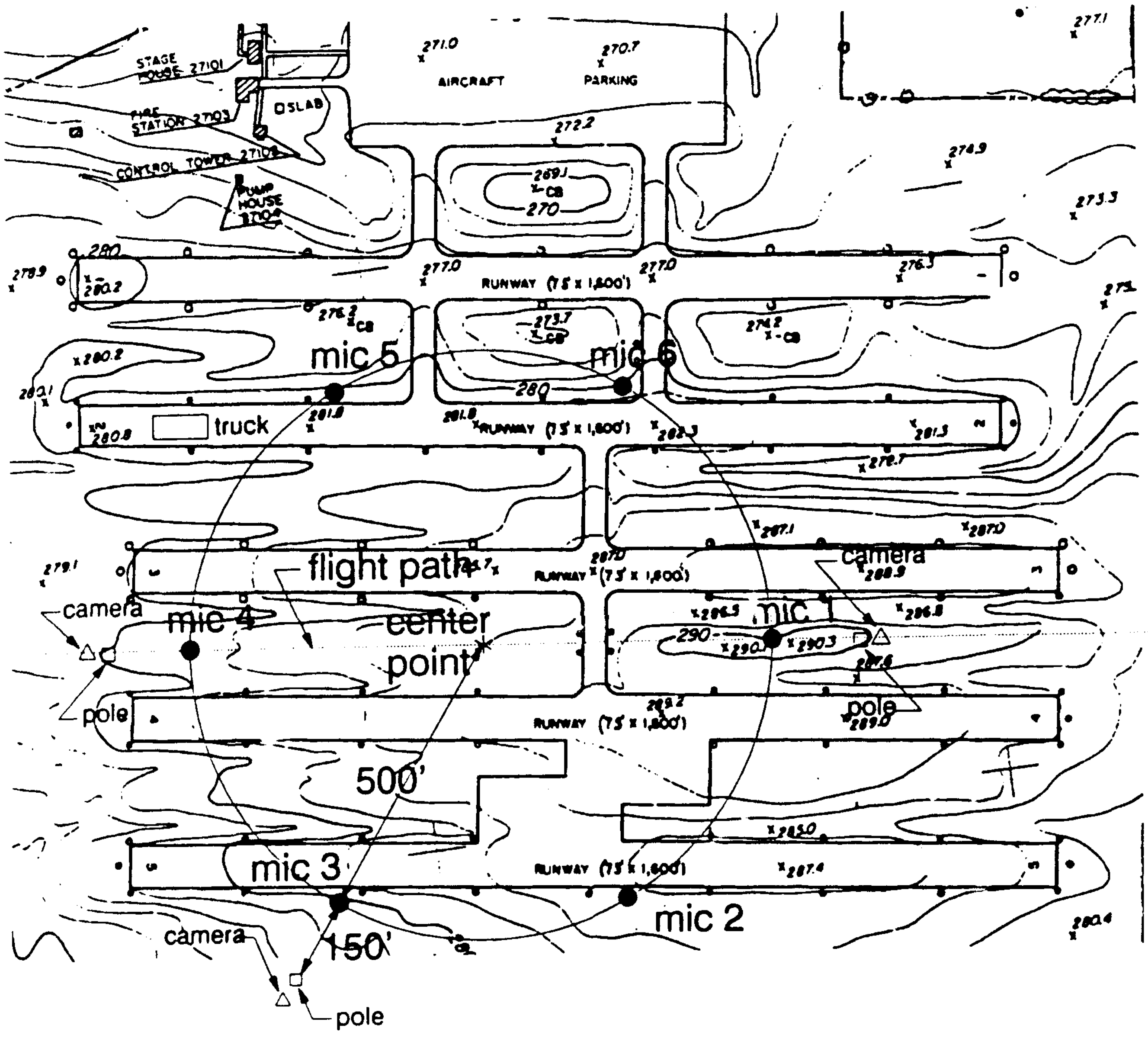

Figure 1. Test Site Layout.

3 DATA REDUCTION AND ANALYSIS

Camera Data

The graduated pole in the foreground of each photograph allowed calculation of altitude and lateral variation over the center of the flight track because the camera angle, distance to the pole, and distance between graduations on the pole were known (Figure 2).

Negatives of each helicopter were projected on the screen of a microfiche reader; measurements were taken in relation to the pole, and data were encoded into a microcomputer for further calculation and analysis. Given the information supplied by the pictures, algorithms were written that located the helicopter in three dimensions at the time the cameras were activated. The slant distance to each of the six microphones in the array was calculated based on the position of the helicopter in space and its forward direction.

Acoustical Signal Analysis

Much of the acoustical analysis performed on the signals was accomplished under automated control of four (two dual-channel and two single-channel) Larson Davis model 3100 Real Time Analyzers (RTAs). Each RTA was programmed to sample the microphone signals throughout a given helicopter operation or maneuver (e.g., flyover, hover) and internally store 1/3-octave band sound pressure levels for every 0.5 second of the operation. At the end of each operation, each RTA scanned its stored spectra and performed further processing according to the specific type of flight operation being performed. For all motionless operations (i.e., hovers and engine idlings), the RTA reported average spectral levels; for all other flights (i.e., take-offs, flyovers, and landings), the RTA reported maximum and average spectra to the controlling computer. The spectra were then "adjusted" to compensate for measurement (or flight) conditions that differed from an ideal standard and were averaged by operation type. The average reference spectra were used to predict the A-weighted sound level as a function of distance from the operation.

Electronic Calibration

The band-to-band response of the RTAs was equalized before the measurements by running each of the RTAs through autocalibration for approximately 10 minutes. In autocalibration, the RTA uses an internal pink noise source for its input and adjusts the 1/3-octave band levels so they report an equal energy response per unit frequency between bands.

The entire electronic system was then calibrated at 1 kHz by adjusting the value displayed by the RTA for the calibration tone to match the known microphone calibrator level (90 dB for all new microphone units and approximately 90 dB for recalibrated microphones). The RTAs automatically scaled all other 1/3-octave bands by the same factor. This procedure assumes that all other equipment in the measurement and recording system had a flat response over the frequency range 10 Hz to 10 kHz.

Indeed, manufacturer's specifications indicate a flat equipment response within a 2 dB tolerance, but researchers did not perform rigorous tests to prove this. The electronic system noise and ambient acoustic noise was sampled and analyzed by the same procedures used for static flight operations, i.e., for hovers and idle, with the aircraft far away from the test site. Before each set of tests the average

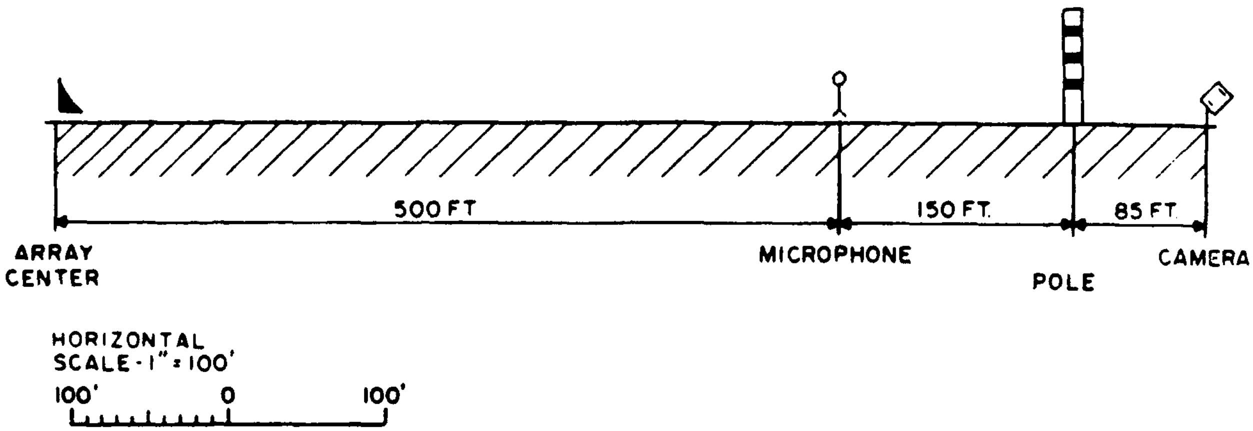

Figure 2. Typical Camera Site.

"background" spectrum was stored in the RTAs as "user" frequency weighting curves for later use in flyover analysis.

Operation of the RTA

The RTA digitally synthesizes consecutive 1/3-octave band filter responses of the input signal. Each 1/3-octave signal is further processed within the RTA by an RMS (Root-Mean-Square) detector, an exponential decay response averager, and a logarithmic detector (for decibel results). Every 0.5 second during sampling, the RTA stores a new spectrum in a set of internal memory registers capable of holding about 240 spectra. The spectra stored there were the slow-time-average response and the 1/3-octave band sound pressure levels. A slow-time-average response filter contains an integrator circuit with a decay time constant of 1.0 second. Thus, the slow-time-average sound level as a function of time can be determined by:

$$L_{p\tau,i}(t) = 10 \log_{10}\left\{\frac{1}{\tau}\int_{-\infty}^{t}\frac{p_i^2(\psi)}{p_o^2}e^{-(t-\psi)/\tau}d\psi\right\} \qquad \text{[Eq 1]}$$

where τ = 1.0 second
ψ = time
$p_i(\psi)$ = the i[th] 1/3-octave band frequency-weighted sound pressure at time ψ.
p_o = the reference sound pressure, 20 µPa (micropascals).

The center frequency, f_i, of the i^{th} 1/3-octave band can be found from the relation:

$$f_i = 10^{i/10} \text{ Hz.} \qquad \text{[Eq 2]}$$

Hover Signal Analysis

For static operations, the RTAs were programmed to store slow-time-averaged 1/3-octave band sound pressure levels in the internal registers and perform "energy averages" Log-Mean-Antilog (LMA) averages of the bands over the entire measurement interval (usually 60 seconds). The LMA average may be written:

$$L_{AV} = 10 \log_{10}\left\{\frac{1}{N}\sum_{j=1}^{N} 10^{L_j/10}\right\} \quad \text{[Eq 3]}$$

where N = the number of levels L_j to be averaged
j = a particular 1/2 second of the measurement interval.

Note that an LMA average of sound pressure levels is equivalent to an average RMS pressure and therefore represents the same measure of energy as an RMS pressure average. The average spectra were reported to and stored on the controlling computer.

Flyover Signal Analysis

During the flyover measurements, the RTAs were triggered to begin and end sampling data at specified times and positions along the flight. Under control of the ''Pass-by'' program (contained in read-only-memory chips in the RTAs), the maximum slow-time-average 1/3-octave band spectrum and the average level per band between the minus 10 dB times was determined. The Pass-by program applied both ''user'' and A-weighting frequency response curves to each 1/2 second spectrum and summed the spectral components to obtain an estimate of the true slow-time-average signal level every 1/2 second. The program searched these values of the slow A-weighted signal to find the 1/2 second time for which the signal reached its maximum value and the time before and after maximum at which the signal fell to more than 10 dB below maximum. The unweighted spectrum for this maximum 1/2 second was reported to the controlling computer. The Pass-by program further performed an LMA average over the spectra lying between the minus 10 dB times. This LMA spectrum was also reported to the controlling computer, along with the time interval between the minus 10 dB times.

Spectral Normalization

Many things affect helicopter sound emissions and the transmission of those sounds to listeners on the ground. Environmental conditions (e.g., temperature, wind, etc.) typically vary from test to test and from run to run in any given set of measurements. The precise flight speed, altitude, and flight path also vary between flights within the same operational category. However, the spectra obtained from these measurements should be relatively free from the effects of nonstandard environmental conditions or non-ideal flight along the target track; it should represent a true measure of the noise emissions of a particular helicopter operating within some standard set of conditions, environment, and distance. The Federal Aviation Association (FAA) regulations[5] for noise certification of fixed-wing aircraft provide guidelines

[5] *Federal Aviation Regulations, Part 36 Noise Standards*, "Aircraft Type and Airworthiness Certification" (U.S. Department of Transportation, June 1974).

for adjusting a spectrum from measurement conditions to "standard" conditions. Many of the procedures outlined in that document have been followed in developing helicopter source spectra for this research. Where possible, the FAR Part 36 requirements have been met or exceeded; however, some extensions to the standard were necessary to obtain reliable results. For example, the guidelines specify that the analysis equipment for noise levels have an operating frequency range of 50 Hz to 10 kHz, but the main blade passage frequency of the OH-58D, thus most of its acoustic energy, lies below 50 Hz.

Compensation for nonideal measurement and flight conditions was made with a simple sound propagation model. In this model, the sound pressure at a particular frequency is assumed to decrease with distance from a point source of sound, according to:

$$p_f \propto \exp(-\alpha_f r)/r \qquad \text{[Eq 4]}$$

where α_f = the molecular sound absorption coefficient at frequency f
r = the distance between source and field points.

The molecular absorption coefficient for air depends on the frequency of the sound waves and on the temperature, relative humidity, and pressure of the air.

As implemented, this model was applied to the maximum spectrum received by the microphone. It was assumed that the received spectrum was emitted by the helicopter at the instant it passed through the point of closest approach to the microphone. The positioning information obtained from camera photographs was used to locate a flight path parallel to the target flight path, but offset vertically and horizontally. The closest point of approach for each microphone was determined from the offset path, and the distance to that path was used as the slant range (r) in the above relation.

To standardize any measured spectrum, the effects of propagation under measurement conditions must be "removed" and the effects of propagation under standard conditions must be "applied" to the spectrum. Using this procedure, the sound pressure per band in the i^{th} 1/3-octave band is given by:

$$p'_i = p_i\left(\frac{r}{r'}\right)\exp(\alpha_i r - \alpha'_i r') \qquad \text{[Eq 5]}$$

where r = the slant distance
α_i = the molecular absorption coefficient for the i^{th} 1/3-octave band.

In the above, all of the primed variables refer to quantities at standard conditions, and the unprimed quantities refer to measurement conditions.

Note that this sound propagation model does not provide for any reflections or sound absorption by the ground. Also missing from the above model are any effects on sound propagation due to atmospheric refraction or atmospheric turbulence. At the short distances used in these source measurements, it is not likely that atmospheric refraction or turbulence has a great effect on sound propagation. The reflection properties of the ground are fairly significant for individual frequency components of sound waves, but are less significant for 1/3-octave, or other broadband measures of acoustic energy. At longer distances, such as those used in predicting noise in communities around airports, the ground reflection, atmospheric refraction, and turbulence become extremely important.

The only corrections to the measured spectra for nonideal conditions involve the propagation of sound from the helicopter to the microphone. No attempt was made in this research to assess the changes in acoustic power output by the helicopter due to the differences between the test environment and the standard environment. Such differences might include changes in heading or attitude due to flying in the presence of wind or changes in blade pitch to provide the same thrust at higher temperatures. Furthermore, throughout each test, the helicopters became lighter as they burned fuel. The fuel remaining in the tanks was logged for each flight, but no compensation was made in the analysis for the weight differences between flights. All of these factors have been considered for future inclusion in the analysis procedure, but have been ignored in this analysis.

A large sample size may justify ignoring environmental effects on source emissions in some cases. For instance, a given factor may either enhance or reduce the sound power, depending on the environment, but when a large number of tests are performed, the average contribution may be small due to the variety of conditions in the sample. A potentially useful method for assessing the importance of environmental effects of the gathered data is to examine the scatter in the data. One measure of the scatter is the energy variance of the sound levels, given by:

$$\sigma^2 = \frac{1}{N} \sum_{j=1}^{N} \left\{10^{L_{AV}/10} - 10^{L_j/10}\right\}^2 \qquad \text{[Eq 6]}$$

The size of the scatter may be compared with the energy average level of the data by expressing the energy variance in decibels, via:

$$L_{VAR} = 10 \log_{10} \sigma \qquad \text{[Eq 7]}$$

If, for instance, the value of L_{VAR} is significantly below L_{AV} (i.e., 10 dB or more) the scatter in the data do not significantly affect the estimate of L_{AV}. Of course, it is still possible that the environmental factors were left unaccounted for by the propagation model.

4 RESULTS

One-third Octave Spectra

The normalized, flat-weighted 1/3-octave band spectra for each helicopter operation are shown in Figures 3A through 3D. The spectra were taken from the 1/2-second during the peak A-weighted level for dynamic operations and from a time-averaged equivalent sound level for the static operations (Figure 3C). Note the strong peaks in level at band 15 (32 Hz) and band 23 (200 Hz) in Figures 3A and 3B. These are mainly due to the noise generated by the main and tail rotors. Also note that these peaks are present in the IGE and OGE hovers (Figure 3D) but the main blade rotation does not produce a peak at band 15 for the zero-pitch idle. All static operations (Figure 3D) produced additional significant energy at band 20 (100 Hz). The data for Figures 3A through 3D are tabulated in Appendix B.

A-weighted Sound Levels Versus Distance

The maximum A-weighted sound pressure level versus distance curves are given in Figures 4A through 4C. In each figure, the maximum A-weighted sound level is predicted at a range of distances between 100 ft slant range and 50000 ft slant range. These curves were calculated from measured 1/3-octave data, using the procedure outlined in an earlier USACERL Technical Report.[6]

The calculation procedure is the same as that described in Chapter 3 of this report.

The A-weighted sound exposure level is plotted versus distance in Figures 5A through 5C. The A-weighted equivalent level is plotted versus distance in Figure 6 for zero-pitch idle, IGE and OGE hovers. Tabulated values for the graphs in Figures 4A through 4C, 5A through 5C and 6 are given in Appendix C.

Sound Exposure Level Versus Speed

Figure 7 shows the variation of the ASEL and ALMX with increasing helicopter speed. The ASEL is actually very constant with respect to speed, with only a 2.1 dB difference (when normalized to 250 ft) between the quietest and the noisiest events. ALMX increases monotonically with helicopter speed, since it is independent of the duration of the flyover.

[6] R. Raspet, M. Kief, and R. Daniels, *Prediction and Modeling of Helicopter Noise*, Technical Report N-186/ADA145764 (USACERL, August 1984).

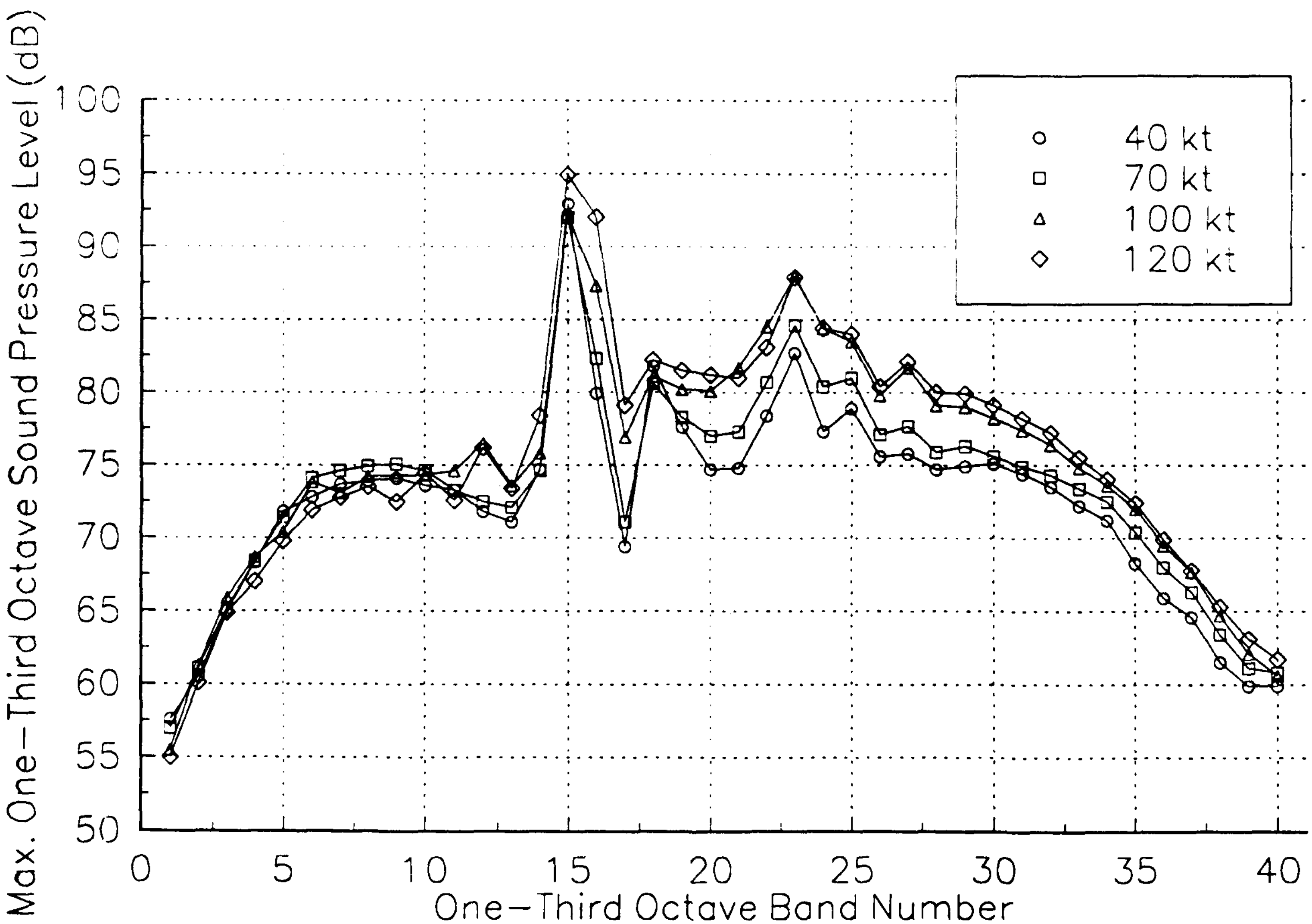

Figure 3A. ALMX Versus One-third Octave Band for a Level Flyover at 300 ft.

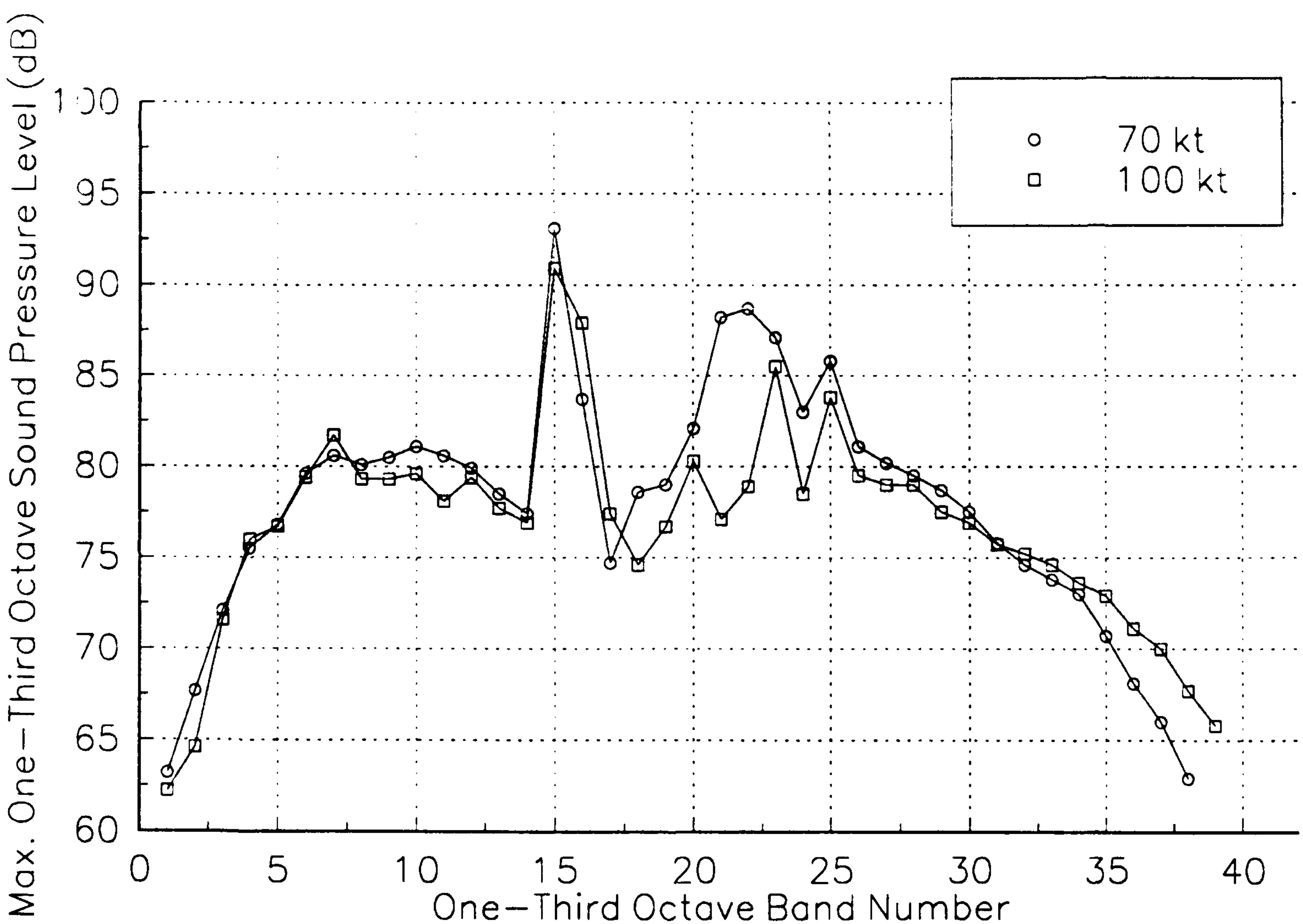

Figure 3B. ALMX Versus One-third Octave Band for a Level Flyover at 1000 ft.

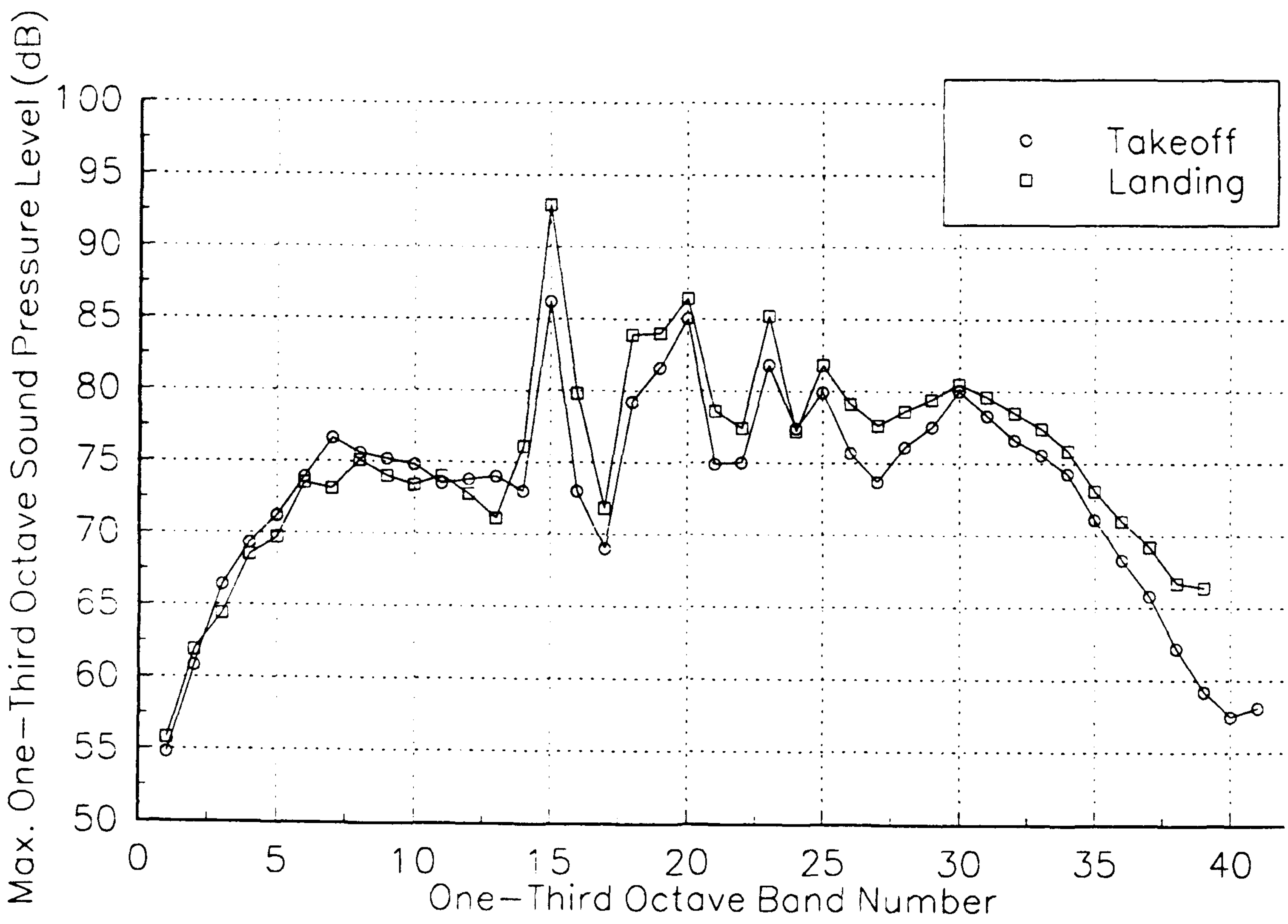

Figure 3C. ALMX Versus One-third Octave Band for Takeoff and Landing.

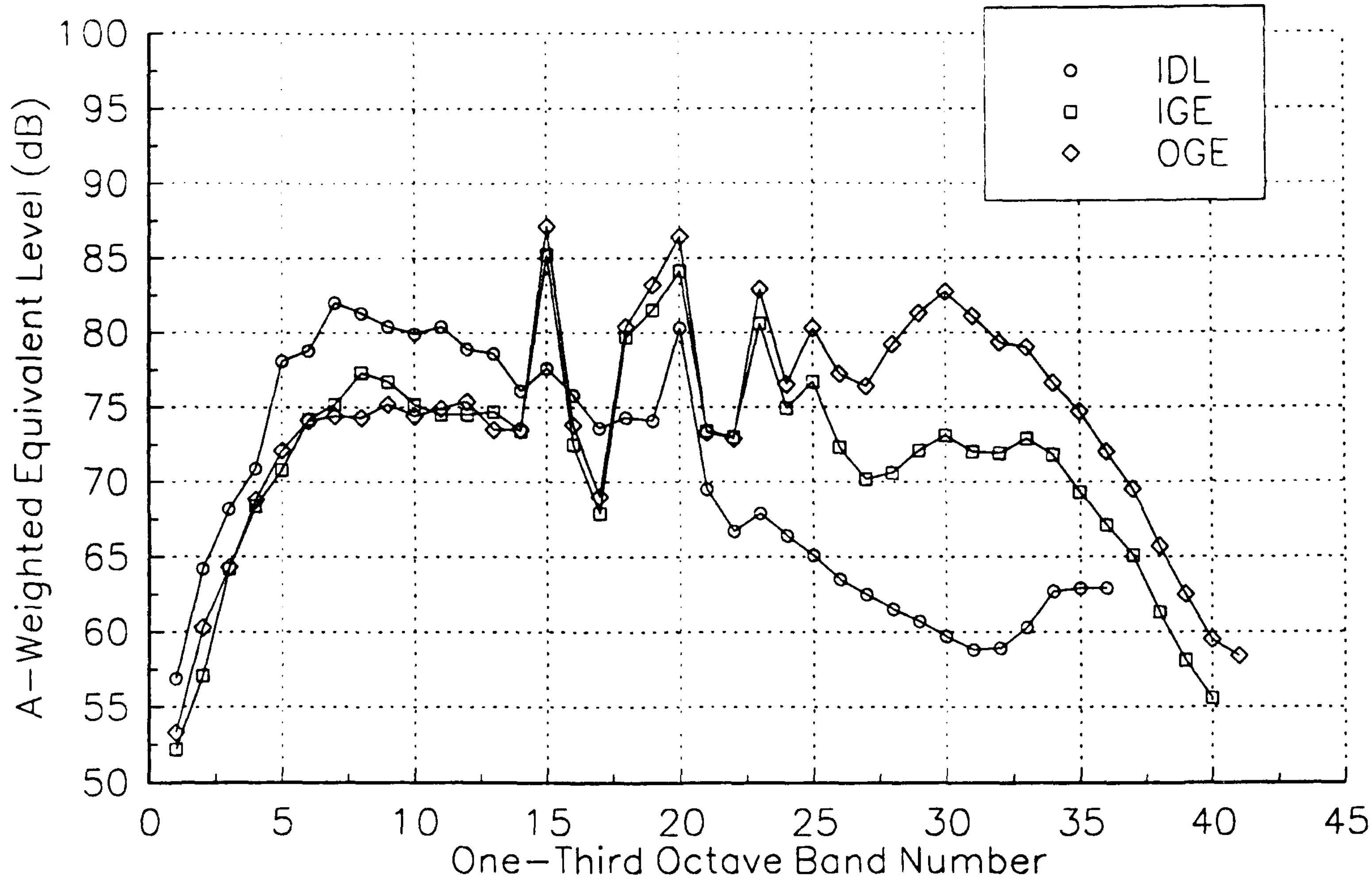

Figure 3D. ALEQ Versus One-third Octave Band for Hovers.

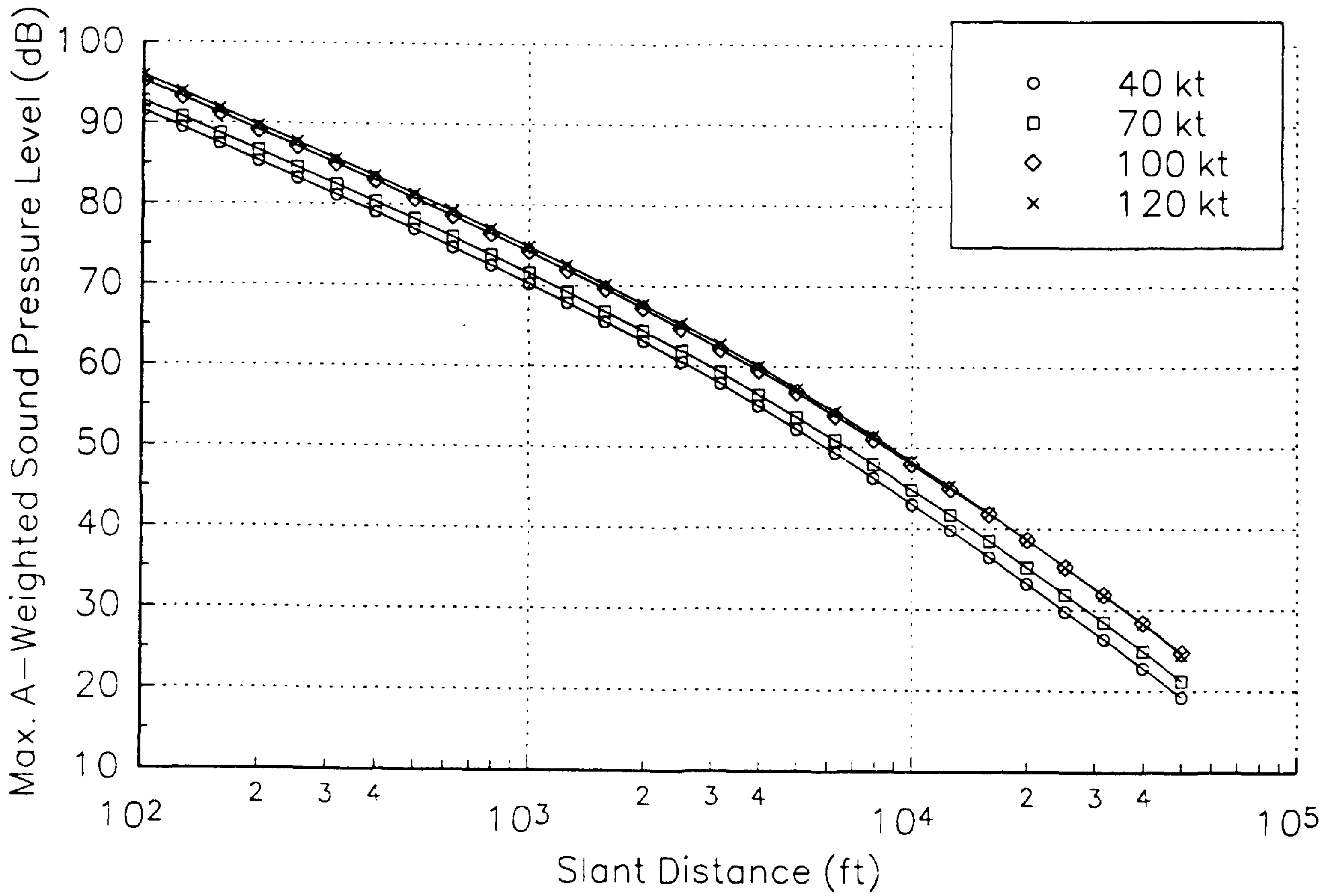

Figure 4A. ALMX Versus Slant Distance for a Level Flyover at 300 ft.

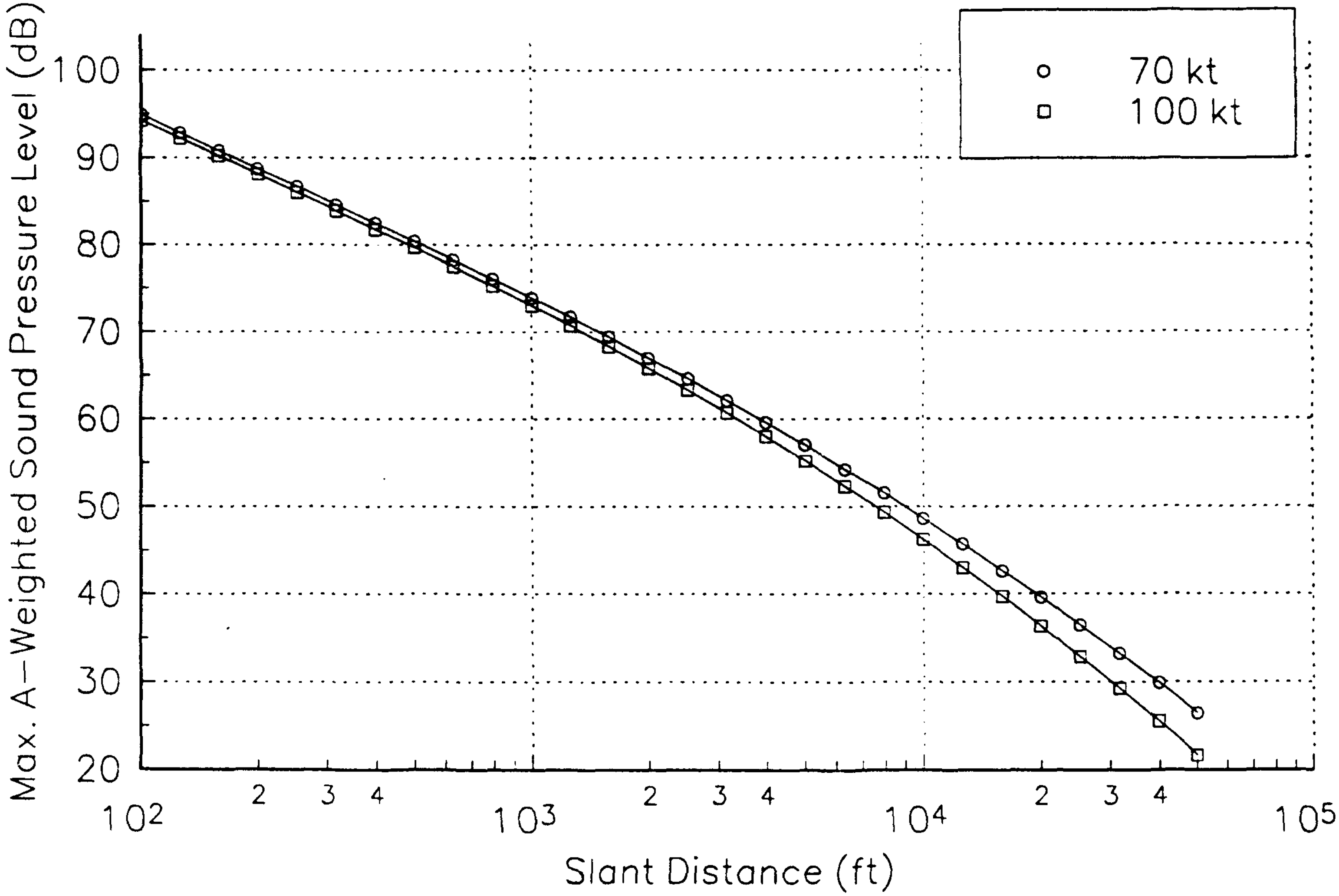

Figure 4B. ALMX Versus Slant Distance for a Level Flyover at 1000 ft.

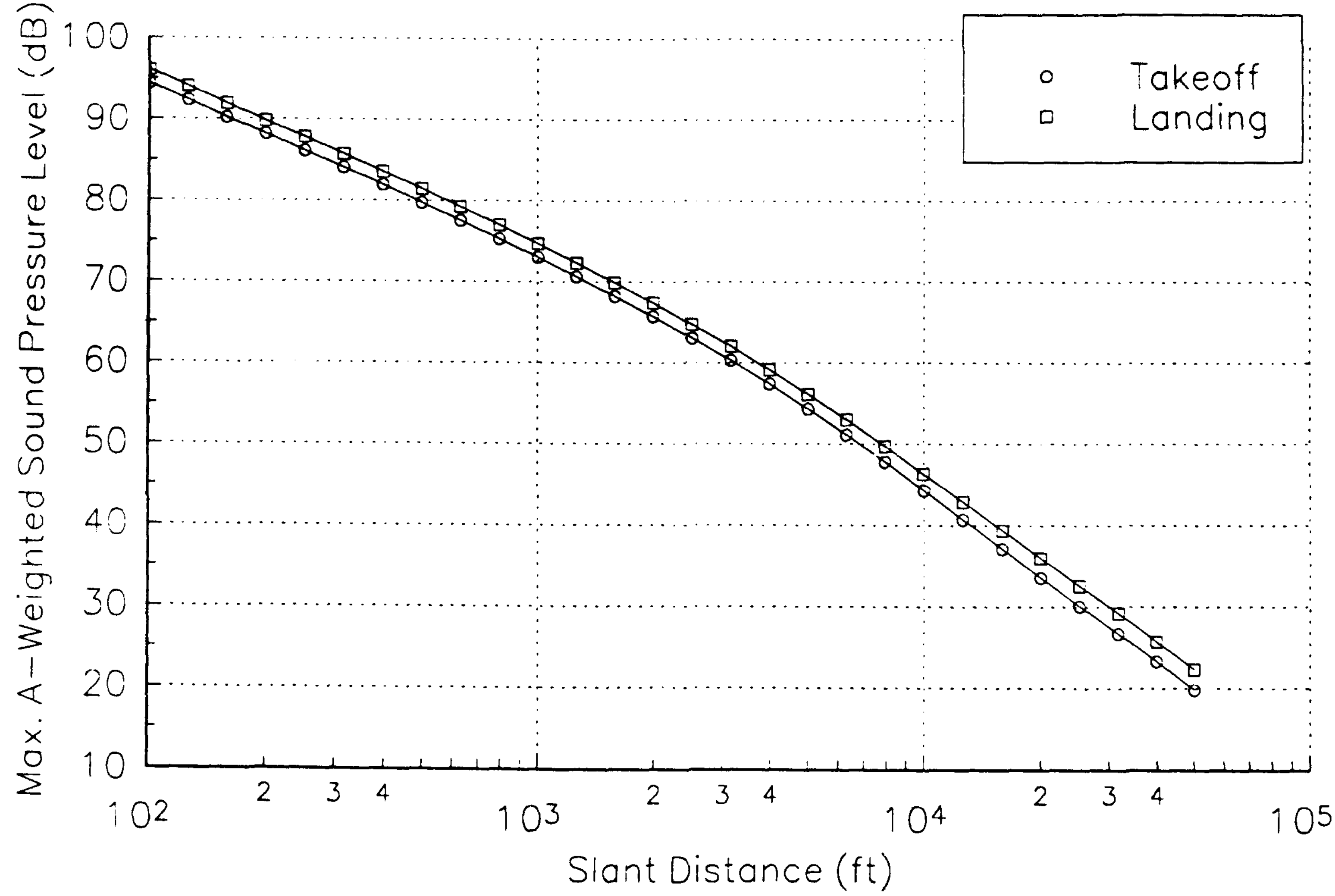

Figure 4C. ALMX Versus Slant Distance for Takeoff and Landing.

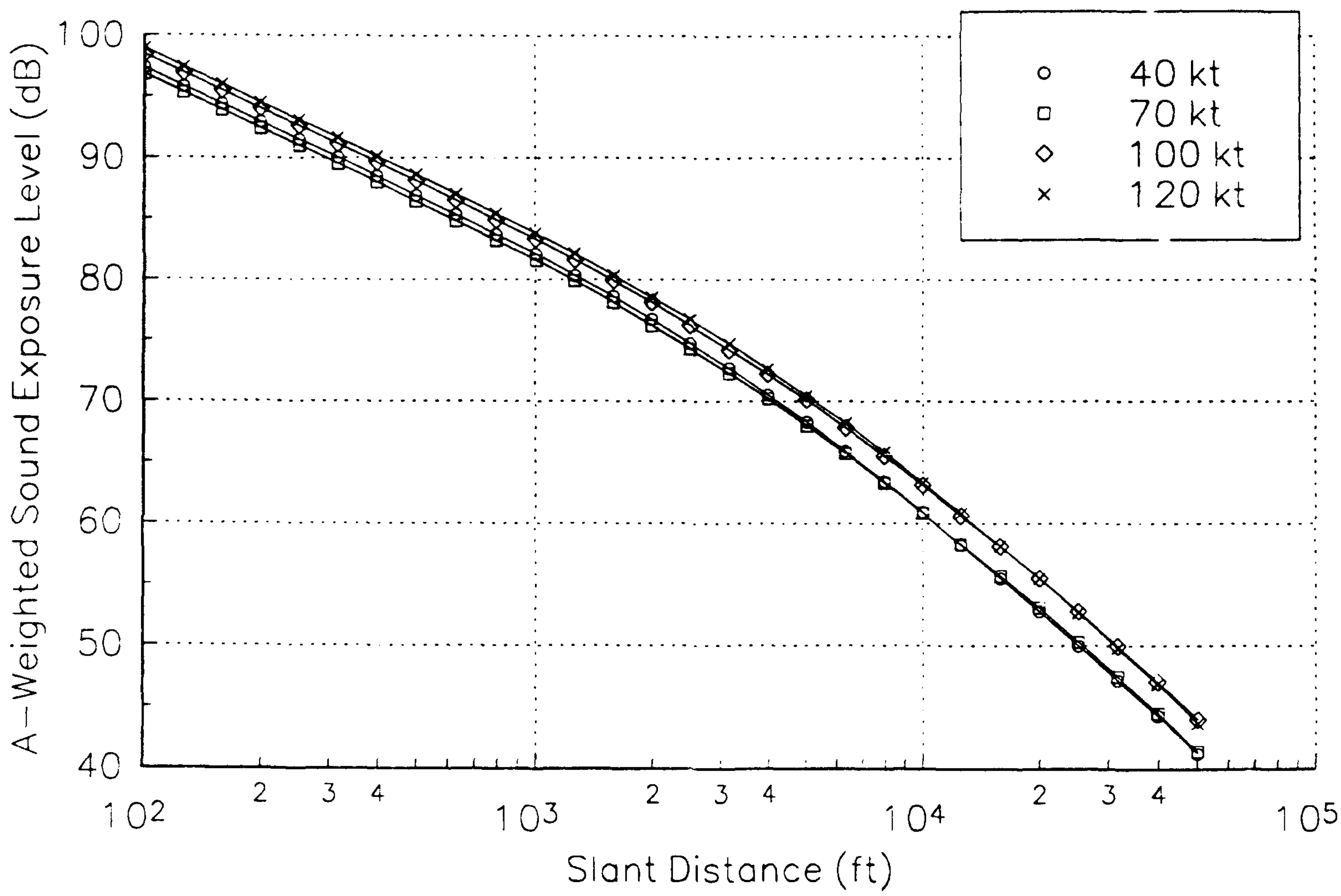

Figure 5A. ASEL Versus Slant Distance for a Level Flyover at 300 ft.

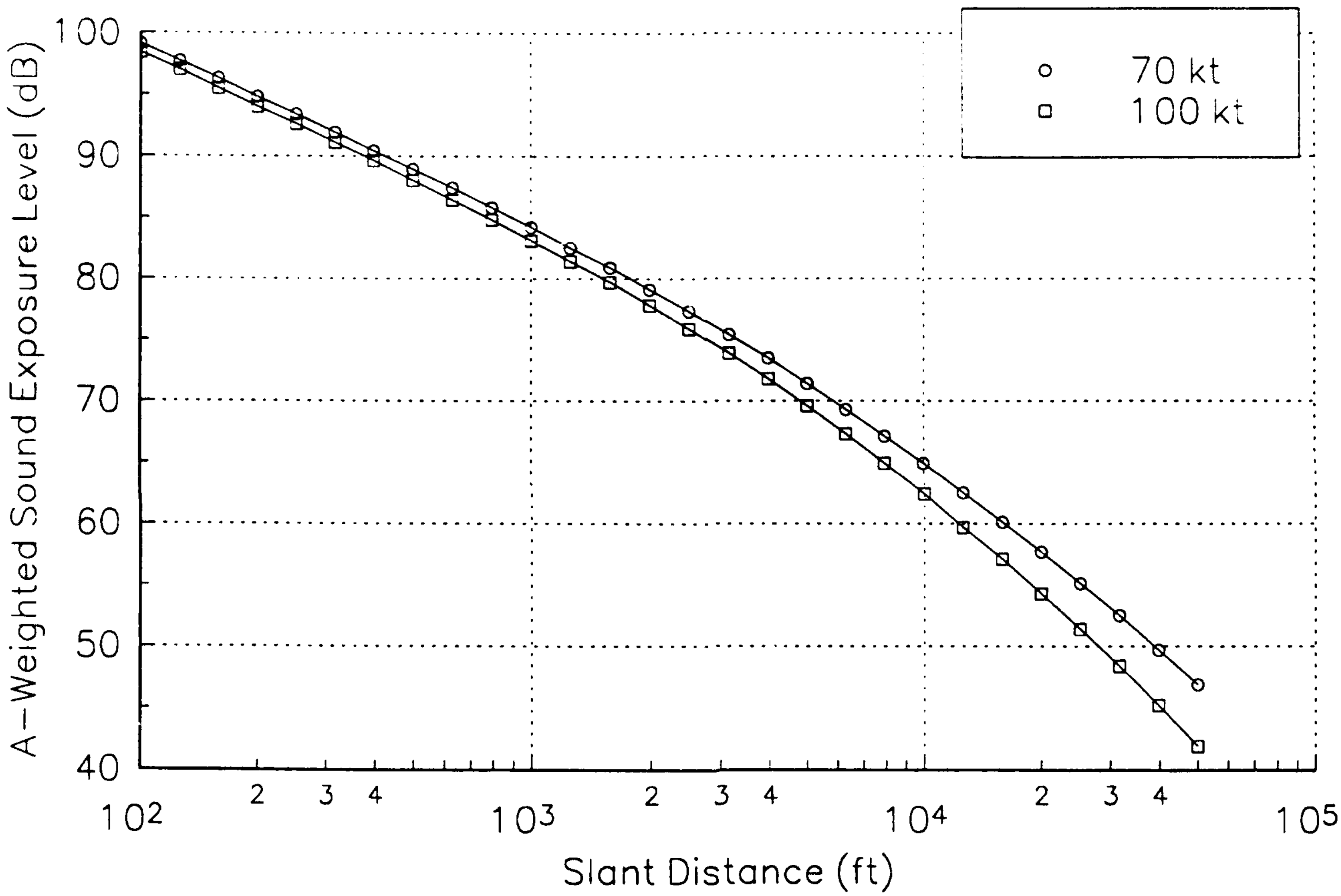

Figure 5B. ASEL Versus Slant Distance for a Level Flyover at 1000 ft.

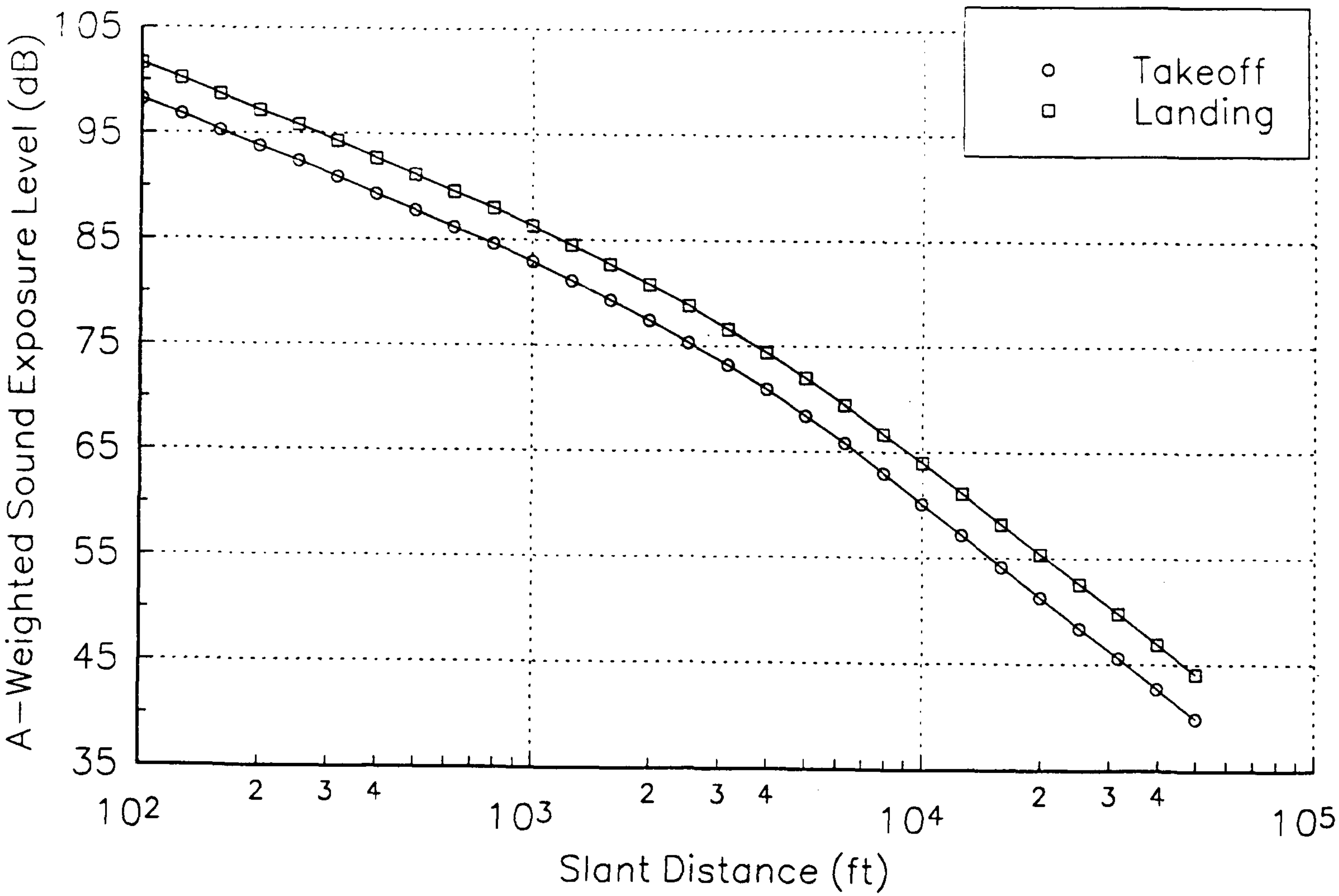

Figure 5C. ASEL Versus Slant Distance for Takeoff and Landing.

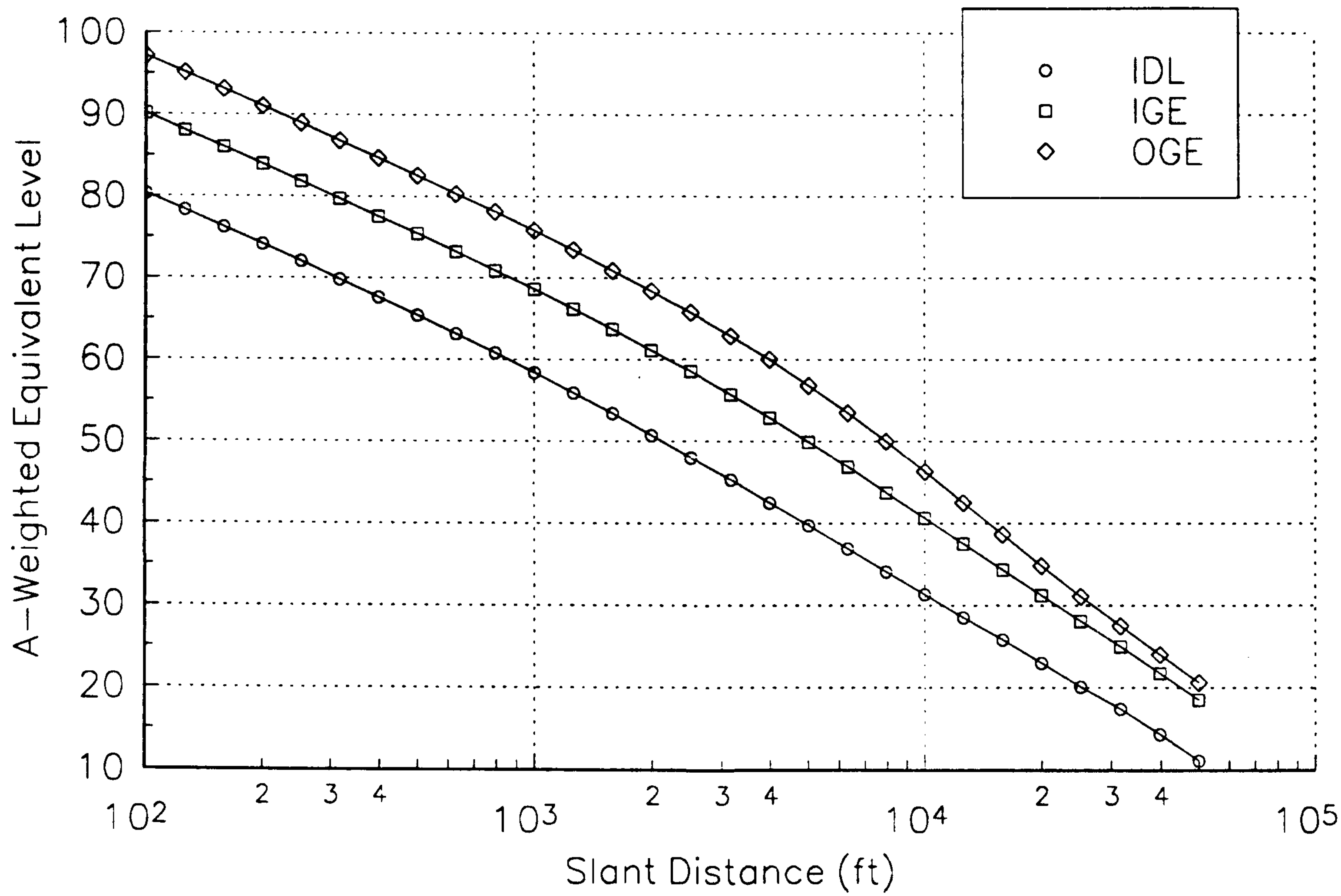

Figure 6. ALEQ Versus Slant Distance for Hovers.

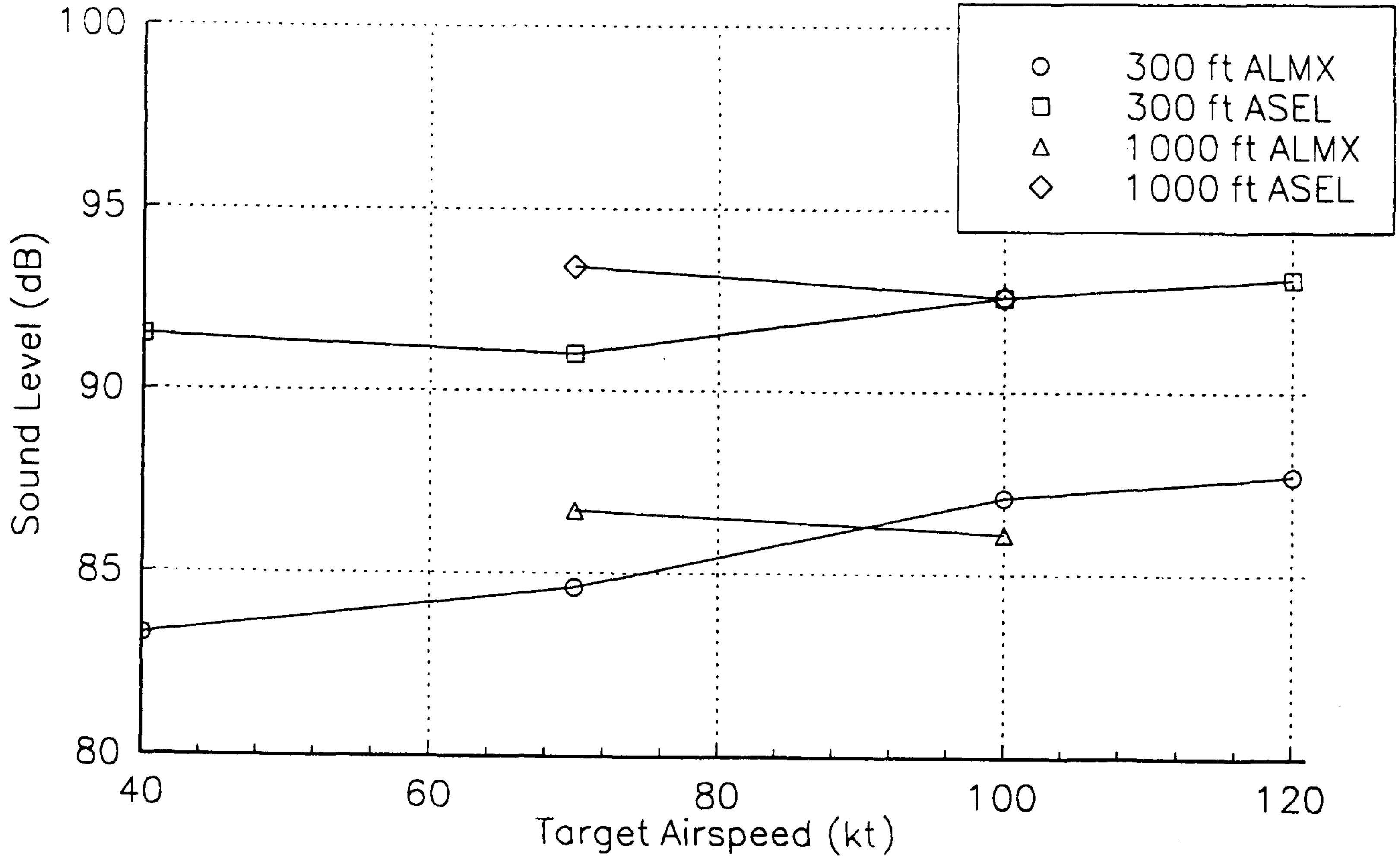

Figure 7. Sound Level Versus Airspeed for ALMX and ASEL.

5 SUMMARY

Noise emission data were gathered in 8 sets of up to 31 helicopter operations. These data were then reduced, analyzed, and normalized to 250 ft for use in noise maps. The ASEL versus distance curves for the OH-58D were then developed.

METRIC CONVERSION TABLE

1 in.	=	25.4 mm
1 ft	=	0.305 m
1 mi	=	1.61 km
1 knot	=	0.514 m/s
1 nmi	=	1.853 km

APPENDIX A: Pilot's Log for OH-58D

Run Number 1 takeoff

LEVEL FLYOVER

GT -- ~~6, 12, 18, 24, 30, 36~~ 28

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading ______

At 1-1/2 mile before beginning of runway,
radio "Mark"

Mark time 0831

Set Alt [redacted] 270

Record,

Height AGL 0-300 feet

Pressure Alt 270-570 feet

FAT 12 oC

Airspeed 0-60 kts (IAS)

Gndspeed 0-83 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 280

Engine Torque #1 57 % #2 62 %

Fuel lbs (total) 552 lbs.

Run Number 2

LEVEL FLYOVER

GT -- ~~6, 12, 18, 24, 30, 36~~ 10

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading ______

At 1-1/2 mile before beginning of runway,
radio "Mark"

Mark time 0834

Set Alt [redacted] 270

Record,

Height AGL 250 feet

Pressure Alt 520 feet

FAT 12 oC

Airspeed 109 kts (IAS)

Gndspeed 103 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 095

Engine Torque #1 65 % #2 98 %

Fuel lbs (total) 562 lbs.

Run Number 3

LEVEL FLYOVER

GT -- ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~ 28

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading 0840

At 1-1/2 mile before beginning of runway, radio "Mark"

Mark time ______

Set Alt [redacted] 270

Record,

Height AGL 285 feet

Pressure Alt 560 feet

FAT 12 oC

Airspeed 103 kts (IAS)

Gndspeed 119 kts (from Doppler)

Rotorspeed 106 % (100 = 225 rpm)

A/C Heading 287

Engine Torque #1 ~~[illegible]~~ 75 % #2 87 %

Fuel lbs (total) 552 lbs.

Run Number 4

LEVEL FLYOVER

GT -- ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~ 10

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading ______

At 1/2 mile before beginning of runway, radio "Mark"

Mark time 0847

Set Alt [redacted] 270

Record,

Height AGL 295 feet

Pressure Alt 580 feet

FAT 14 oC

Airspeed 48 kts (IAS)

Gndspeed 36 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 090

Engine Torque #1 41 % #2 50 %

Fuel lbs (total) 480 lbs.

Run Number 5

LEVEL FLYOVER

GT -- 6, 12, 18, 24, 30, 36 28

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading 284

At 1/2 mile before beginning of runway,

radio "Mark"

Mark time 0901   0905

Set Alt [redacted] 270

Record,   A2   #3

Height AGL 295 feet   290

Pressure Alt 590 feet   570

FAT 14 oC   14

Airspeed 44 kts (IAS)   39

Gndspeed 56 kts (from Doppler)   51

Rotorspeed 100 % (100 = 225 rpm)   100

A/C Heading 285   285

Engine Torque #1 42 % #2 51 %   43 52

Fuel lbs (total) 442 lbs.   438

Run Number 6

LEVEL FLYOVER

GT -- ~~6, 12, 18, 24, 30, 36~~ 10

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading ______

At 1-1/2 mile before beginning of runway,

radio "Mark"

Mark time 0907

Set Alt [redacted] 270

Record,

Height AGL 290 feet

Pressure Alt 550 feet

FAT 16 ~~13~~ oC

Airspeed 70 kts (IAS)

Gndspeed 66 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 090

Engine Torque #1 48 % #2 54 %

Fuel lbs (total) 429 lbs.

Run Number 7

LEVEL FLYOVER

GT -- ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~ 28

Altitude: 300 ft. AGL or ____

IAS: 40, 70, 100, 130, max kts

Heading ____

At 1-1/2 mile before beginning of runway, radio "Mark"

Mark time 0911

Set Alt [redacted] 270

Record,

Height AGL 275' feet

Pressure Alt 540 feet

FAT 16 oC

Airspeed 69 kts (IAS)

Gndspeed 81 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 287

Engine Torque #1 50 % #2 58 %

Fuel lbs (total) 405 lbs.

Run Number 8

LEVEL FLYOVER

GT -- ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~ 10

Altitude: 300 ft. AGL or ____

IAS: 40, 70, 100, 130, max kts

Heading ____

At 2 mile before beginning of runway, radio "Mark"

Mark time 0915

Set Alt [redacted] 270

Record,

Height AGL 320 feet

Pressure Alt 600 feet

FAT 16 oC

Airspeed 112 kts (IAS)

Gndspeed 109 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 095

Engine Torque #1 84 % #2 97 %

Fuel lbs (total) 430 lbs.

Run Number 9

LEVEL FLYOVER

GT -- ~~1~~, ~~2~~, ~~18~~, ~~24~~, ~~20~~, ~~38~~, 28

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading______

At 1/2 mile before beginning of runway,
radio "Mark"

Mark time______

Set Alt [redacted] 270

Record,

Height AGL 280 feet

Pressure Alt 540 feet

FAT 16 oC

Airspeed 113 kts (IAS)

Gndspeed 123 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 285

Engine Torque #1 81 % #2 96 %

Fuel lbs (total) 418 lbs.

Run Number 10

LEVEL FLYOVER

GT -- ~~1~~, ~~2~~, ~~18~~, ~~24~~, ~~28~~, ~~38~~, 10

Altitude: ~~300 ft. AGL~~ or 1000 ft AGL

IAS: 40, 70, 100, 130, max kts

Heading______

At 1-1/2 mile before beginning of runway,
radio "Mark"

Mark time 0923

Set Alt [redacted] 270

Record,

Height AGL 1040 feet

Pressure Alt 1040 feet

FAT 18 oC

Airspeed 78 kts (IAS)

Gndspeed 55 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 090

Engine Torque #1 53 % #2 61 %

Fuel lbs (total) 367 lbs.

Run Number 11

LEVEL FLYOVER

GT -- ~~[illegible]~~ 28

Altitude: ~~300 ft. AGL~~ or 1000 ft. AGL

IAS: 40, 70, 100, 130, max kts

Heading ____

At 1-1/2 mile before beginning of runway,
radio "Mark"

Mark time 0926

Set Alt [redacted] 270

Record,

Height AGL 1000 feet

Pressure Alt 1260 feet

FAT 18 oC

Airspeed 69 kts (IAS)

Gndspeed 96 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 285

Engine Torque #1 44 % #2 51 %

Fuel lbs (total) 355 lbs.

Run Number 12

LEVEL FLYOVER

GT -- ~~[illegible]~~ 10

Altitude: 300 ft. AGL or ____

IAS: 40, 70, 100, 130, max kts

Heading ____

At 1-1/2 mile before beginning of runway,
radio "Mark"

Mark time 0429

Set Alt [redacted] 270

Record,

Height AGL 310 feet

Pressure Alt 580 feet

FAT 18 oC

Airspeed 104 kts (IAS)

Gndspeed 97 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 092

Engine Torque #1 72 % #2 84 %

Fuel lbs (total) 358 lbs.

Run Number 13

LEVEL FLYOVER

GT -- 28

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading______

At 1-1/2 mile before beginning of runway,
radio "Mark"

Mark time______

Set Alt [redacted] 270

Record,

Height AGL 305 feet

Pressure Alt 600 feet

FAT 18 oC

Airspeed 98 kts (IAS)

Gndspeed 115 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 285

Engine Torque #1 68 % #2 80 %

Fuel lbs (total) 345 lbs.

Run Number 14 LAND

LEVEL FLYOVER

GT -- 10

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading______

At 1-1/2 mile before beginning of runway,
radio "Mark"

Mark time______

Set Alt [redacted] 270

Record,

Height AGL 300→0 feet

Pressure Alt 580-10 feet

FAT 18 oC

Airspeed 62-0 kts (IAS)

Gndspeed 45-0 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 100

Engine Torque #1 32 % #2 37 %

Fuel lbs (total) 325 lbs.

Run Number 15 Eng. Idle

LEVEL FLYOVER

GT -- ~~6~~, ~~12~~, ~~18~~, ~~24~~, ~~30~~, ~~3~~ 10

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading______

At ~~/~~ 1/2 mile before beginning of runway,

radio "Mark"

Mark time______

Set Alt [redacted] 270

Record,

Height AGL 0 feet

Pressure Alt 270 feet

FAT 16 oC

Airspeed 0 kts (IAS)

Gndspeed 0 kts (from Doppler)

Rotorspeed 74 % (100 = 225 rpm)

A/C Heading 100

Engine Torque #1 ______ % #2 ______ %

Fuel lbs (total) 275 lbs.

Run Number 16 IGE - Hover Into Wind

LEVEL FLYOVER

GT -- 6, 12, 18, 24, 30, 36

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading______

At 1/2 mile before beginning of runway,

radio "Mark"

Mark time 0945

Set Alt [redacted] 270

Record,

Height AGL 3 feet

Pressure Alt 300 feet

FAT 18 oC

Airspeed 0 kts (IAS)

Gndspeed 6 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 010

Engine Torque #1 60 % #2 70 %

Fuel lbs (total) 255 lbs.

Run Number 17 OGE - Hover Into Wind

LEVEL FLYOVER

GT -- 6, 12, 18, 24, 30, 36

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading 010

At 1/2 mile before beginning of runway,

radio "Mark"

Mark time 0146

Set Alt [redacted] 270

Record,

- Height AGL 50 feet
- Pressure Alt 350 feet
- FAT 18 oC
- Airspeed 0 kts (IAS)
- Gndspeed 0 kts (from Doppler)
- Rotorspeed 100 % (100 = 225 rpm)
- A/C Heading 010
- Engine Torque #1 64 % #2 73 %
- Fuel lbs (total) 254 lbs.

Run Number 18 Takeoff

LEVEL FLYOVER

GT -- ~~6~~, ~~12~~, ~~18~~, ~~24~~, ~~30~~, ~~36~~ 10

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading ______

At 1/2 mile before beginning of runway,

radio "Mark"

Mark time ______

Set Alt [redacted] 270

Record,

- Height AGL 0-300 feet
- Pressure Alt 270-600 feet
- FAT 14 oC
- Airspeed 0-60 kts (IAS)
- Gndspeed 0-50 kts (from Doppler)
- Rotorspeed 100 % (100 = 225 rpm)
- A/C Heading 010
- Engine Torque #1 61 % #2 73 %
- Fuel lbs (total) 256 lbs.

Run Number 19

LEVEL FLYOVER

GT -- ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~ 28

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading ______

At 1/2 mile before beginning of runway,
radio "Mark"

Mark time 0854

Set Alt [redacted] 270

Record,

Height AGL 315 feet
Pressure Alt 590 feet
FAT 18 oC
Airspeed 42 kts (IAS)
Gndspeed 52 kts (from Doppler)
Rotorspeed 100 % (100 = 225 rpm)
A/C Heading 282
Engine Torque #1 45 % #2 53 %
Fuel lbs (total) 230 lbs.

Run Number 20

LEVEL FLYOVER

GT -- ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~, ~~[illegible]~~ 10

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading ______

At 1/2 mile before beginning of runway,
radio "Mark"

Mark time 0956

Set Alt [redacted] 270

Record,

Height AGL 300 feet
Pressure Alt 570 feet
FAT 18 oC
Airspeed 41 kts (IAS)
Gndspeed 41 kts (from Doppler)
Rotorspeed 100 % (100 = 225 rpm)
A/C Heading 081
Engine Torque #1 44 % #2 54 %
Fuel lbs (total) 226 lbs.

Run Number 21

LEVEL FLYOVER

GT -- ~~6~~, ~~12~~, ~~18~~, ~~24~~, ~~30~~, ~~36~~ 28

Altitude: 300 ft. AGL or ____

IAS: 40, 70, 100, 130, max kts

Heading ____

At ~~1/2~~ 2 mile before beginning of runway, radio "Mark"

Mark time 1001

Set Alt 270

Record,

Height AGL 270 feet

Pressure Alt 540 feet

FAT 18 oC

Airspeed 108 kts (IAS)

Gndspeed 124 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 280

Engine Torque #1 83 % #2 99 %

Fuel lbs (total) 234 lbs.

Run Number 22

LEVEL FLYOVER

GT -- ~~6~~, ~~12~~, ~~18~~, ~~24~~, ~~30~~, ~~36~~ 10

Altitude: 300 ft. AGL or ____

IAS: 40, 70, 100, 130, max kts

Heading ____

At ~~1/2~~ 2 mile before beginning of runway, radio "Mark"

Mark time 1005

Set Alt 270

Record,

Height AGL 240 feet

Pressure Alt 500 feet

FAT 18 oC

Airspeed 111 kts (IAS)

Gndspeed 107 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 094

Engine Torque #1 82 % #2 96 %

Fuel lbs (total) 233 lbs.

Run Number 23

LEVEL FLYOVER

GT -- ~~1~~, ~~12~~, ~~18~~, ~~24~~, ~~30~~, ~~36~~ 28

Altitude: 300 ft. AGL or 1000 ft. AGL

IAS: 40, 70, 100, 130, max kts

Heading _____

1 1/2 At [redacted] 2 mile before beginning of runway, radio "Mark"

Mark time 1007

Set Alt [redacted] 270

Record,

Height AGL 1040 feet

Pressure Alt 1300 feet

FAT 18 oC

Airspeed 65 kts (IAS)

Gndspeed 81 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 289

Engine Torque #1 50 % #2 57 %

Fuel lbs (total) 200 lbs.

Run Number 24

LEVEL FLYOVER

GT -- ~~1~~, ~~12~~, ~~18~~, ~~24~~, ~~30~~, ~~36~~ 10

Altitude: ~~300 ft. AGL~~ or 1000 ft. AGL

IAS: 40, 70, 100, 130, max kts

Heading _____

1 1/2 At [redacted] 2 mile before beginning of runway, radio "Mark"

Mark time _____

Set Alt [redacted] 270

Record,

Height AGL 990 feet

Pressure Alt 1230 feet

FAT 18 oC

Airspeed 69 kts (IAS)

Gndspeed 61 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 092

Engine Torque #1 55 % #2 64 %

Fuel lbs (total) 190 lbs.

Run Number 25

LEVEL FLYOVER

GT -- ~~4~~, ~~12~~, ~~18~~, ~~24~~, ~~26~~, ~~26~~ 28

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading ______

At 1-1/2 mile before beginning of runway,

radio "Mark"

Mark time 1035

Set Alt ~~[illegible]~~ 270

Record,

Height AGL 200 feet

Pressure Alt 576 feet

FAT 20 oC

Airspeed 100 kts (IAS)

Gndspeed 113 kts (from Doppler)

Rotorspeed 106 % (100 = 225 rpm)

A/C Heading 283

Engine Torque #1 07 % #2 78 %

Fuel lbs (total) 170 lbs.

Run Number 26

LEVEL FLYOVER

GT -- ~~4~~, ~~12~~, ~~18~~, ~~24~~, ~~26~~, ~~28~~ 10

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading ______

At 1-1/2 mile before beginning of runway,

radio "Mark"

Mark time 1039

Set Alt ~~[illegible]2~~ 270

Record,

Height AGL 260 feet

Pressure Alt 520 feet

FAT 20 oC

Airspeed 102 kts (IAS)

Gndspeed 96 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 095

Engine Torque #1 72 % #2 64 %

Fuel lbs (total) ~~645~~ 637 lbs.

Run Number 27

LEVEL FLYOVER

GT -- ~~6~~, ~~12~~, ~~18~~, ~~24~~, ~~30~~, ~~36~~ 28

Altitude: 300 ft. AGL or ____

IAS: 40, 70, 100, 130, max kts

Heading ____

At/-1/2 mile before beginning of runway,
radio "Mark"

Mark time ____

Set Alt [redacted] 270

Record,

Height AGL 280 feet

Pressure Alt 560 feet

FAT 20 oC

Airspeed 61 kts (IAS)

Gndspeed 62 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 285

Engine Torque #1 47 % #2 55 %

Fuel lbs (total) 645 lbs.

Run Number 28

LEVEL FLYOVER

GT -- ~~6~~, ~~12~~, ~~18~~, ~~24~~, ~~30~~, ~~36~~ 10

Altitude: 300 ft. AGL or ____

IAS: 40, 70, 100, 130, max kts

Heading ____

At/-1/2 mile before beginning of runway,
radio "Mark"

Mark time ____

Set Alt [redacted] 270

Record,

Height AGL 230 feet

Pressure Alt 500 feet

FAT 20 oC

Airspeed 65 kts (IAS)

Gndspeed 67 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 276

Engine Torque #1 57 % #2 67 %

Fuel lbs (total) 605 lbs.

Run Number 29

LEVEL FLYOVER

GT -- ~~6~~, ~~12~~, ~~18~~, ~~24~~, ~~30~~, ~~36~~ 28

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading______

At 1-1/2 mile before beginning of runway,
radio "Mark"

Mark time 1055

Set Alt [redacted] 270

Record,

Height AGL 270 feet

Pressure Alt 540 feet

FAT 20 oC

Airspeed 99 kts (IAS)

Gndspeed 117 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 286

Engine Torque #1 74 % #2 95 %

Fuel lbs (total) 600 lbs.

Run Number 30

LEVEL FLYOVER

GT -- ~~6~~, ~~12~~, ~~18~~, ~~24~~, ~~30~~, ~~36~~ 10

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading______

At 1-1/2 mile before beginning of runway,
radio "Mark"

Mark time 1064

Set Alt [redacted] 270

Record,

Height AGL 280 feet

Pressure Alt 550 feet

FAT 20 oC

Airspeed 100 kts (IAS)

Gndspeed 93 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 095

Engine Torque #1 ~~60~~ 74 % #2 81 %

Fuel lbs (total) 600 lbs.

Run Number 31   LAND

LEVEL FLYOVER

GT -- ~~[illegible], [illegible], [illegible], [illegible], 30, 36~~ 28

Altitude: 300 ft. AGL or ______

IAS: 40, 70, 100, 130, max kts

Heading______

At 1/2 mile before beginning of runway,
radio "Mark"

Mark time______

Set Alt ~~[illegible]~~

Record,

Height AGL 300→70 feet

Pressure Alt 570→[illegible] feet

FAT 20 oC

Airspeed 60→0 kts (IAS)

Gndspeed 55→0 kts (from Doppler)

Rotorspeed 100 % (100 = 225 rpm)

A/C Heading 265

Engine Torque #1 30 % #2 35 %

Fuel lbs (total) 551 lbs.

APPENDIX B:

One-third Octave Band Data Normalized to 250 ft

```
oh58d IDL LITE    0FT   0KTS
REFERENCE SLNT  250FT   0KTS  59DEGF  70PCTRH 29.92IN.HG
AVGN  40
AVG ALEQ 720
AVG 1/3-OCTAVE BANDS 0-43, 30 SEC LEQ
 569 642 682 709 781 788 820 813 804 799
 804 789 786 761 776 758 736 743 741 803
 695 667 679 664 651 635 625 615 607 597
 588 589 603 627 629 629   0   0   0   0
   0   0   0   0
END

oh58d IGE LITE    2FT   0KTS
REFERENCE SLNT  250FT   0KTS  59DEGF  70PCTRH 29.92IN.HG
AVGN  40
AVG ALEQ 818
AVG 1/3-OCTAVE BANDS 0-43, 30 SEC LEQ
 522 571 642 684 708 742 752 773 767 752
 745 745 747 734 852 725 679 797 815 841
 734 730 806 749 767 723 702 706 721 731
 720 719 729 718 693 671 651 613 581 556
   0   0   0   0
END

oh58d LFO LITE  300FT  40KTS
REFERENCE SLNT  250FT  40KTS  59DEGF  70PCTRH 29.92IN.HG
AVGN 165
AVG ALMX 833
AVG ASEL 915
AVG 1/3-OCTAVE BANDS 0-43, MAX 1/2 SEC SLOW AL
 576 605 650 683 718 728 737 739 741 736
 733 718 711 747 929 799 694 818 776 747
 748 784 827 773 789 756 758 747 749 751
 744 735 722 712 683 659 646 615 599 599
   0   0   0   0
END

oh58d LFO LITE  300FT  70KTS
REFERENCE SLNT  250FT  70KTS  59DEGF  70PCTRH 29.92IN.HG
AVGN 218
AVG ALMX 846
AVG ASEL 910
AVG 1/3-OCTAVE BANDS 0-43, MAX 1/2 SEC SLOW AL
 570 611 652 684 714 741 746 749 751 746
 733 725 721 746 920 823 711 806 783 770
 773 807 846 804 810 771 777 759 763 756
 749 743 734 725 704 680 663 634 611 608
   0   0   0   0
END

oh58d LFO LITE  300FT 100KTS
REFERENCE SLNT  250FT 100KTS  59DEGF  70PCTRH 29.92IN.HG
AVGN 232
AVG ALMX 871
AVG ASEL 926
AVG 1/3-OCTAVE BANDS 0-43, MAX 1/2 SEC SLOW AL
```

```
 555 613 659 687 704 738 731 742 743 743
 746 765 736 758 922 873 769 811 802 801
 817 845 880 844 835 798 817 791 790 782
 774 764 748 736 720 695 677 647 621 606
   0   0   0   0
END

oh58d LFO LITE  300FT 120KTS
REFERENCE SLNT  250FT 120KTS  59DEGF  70PCTRH 29.92IN.HG
AVGN 170
AVG ALMX 877
AVG ASEL 931
AVG 1/3-OCTAVE BANDS 0-43, MAX 1/2 SEC SLOW AL
 550 601 649 670 698 719 728 735 725 744
 726 762 734 784 949 920 791 822 815 812
 810 831 879 844 840 804 821 800 799 791
 782 772 755 740 724 699 678 653 631 617
   0   0   0   0
END

oh58d LFO LITE 1000FT  70KTS
REFERENCE SLNT  250FT  70KTS  59DEGF  70PCTRH 29.92IN.HG
AVGN  77
AVG ALMX 867
AVG ASEL 934
AVG 1/3-OCTAVE BANDS 0-43, MAX 1/2 SEC SLOW AL
 632 677 721 755 768 796 806 801 805 811
 806 799 785 774 931 837 747 786 790 821
 882 887 871 830 858 811 802 795 787 775
 758 746 738 730 707 681 660 629   0   0
   0   0   0   0
END

oh58d LFO LITE 1000FT 100KTS
REFERENCE SLNT  250FT 100KTS  59DEGF  70PCTRH 29.92IN.HG
AVGN  74
AVG ALMX 861
AVG ASEL 926
AVG 1/3-OCTAVE BANDS 0-43, MAX 1/2 SEC SLOW AL
 622 646 716 760 767 794 817 793 793 796
 781 794 777 769 909 879 774 746 767 803
 771 789 855 785 838 795 790 790 775 769
 757 752 746 736 729 711 700 677 658   0
   0   0   0   0
END

oh58d LND LITE  300FT  40KTS
REFERENCE SLNT  250FT  40KTS  59DEGF  70PCTRH 29.92IN.HG
AVGN  59
AVG ALMX 878
AVG ASEL 958
AVG 1/3-OCTAVE BANDS 0-43, MAX 1/2 SEC SLOW AL
 558 619 644 685 697 735 731 751 740 734
 740 728 711 761 929 798 718 839 840 864
 786 774 852 772 818 791 776 786 794 805
 796 785 774 759 731 710 692 667 664   0
```

```
   0    0    0    0
END

oh58d OGE LITE    50FT    0KTS
REFERENCE SLNT   250FT    0KTS   59DEGF   70PCTRH 29.92IN.HG
AVGN  40
AVG ALEQ 890
AVG 1/3-OCTAVE BANDS 0-43, 30 SEC LEQ
 533 603 643 688 721 741 744 743 752 744
 749 754 735 735 871 738 690 804 832 864
 733 729 829 765 803 772 764 792 813 827
 811 793 790 766 747 720 695 657 625 595
 584   0   0   0
END

oh58d TKF LITE   300FT   40KTS
REFERENCE SLNT   250FT   40KTS   59DEGF   70PCTRH 29.92IN.HG
AVGN  65
AVG ALMX 861
AVG ASEL 924
AVG 1/3-OCTAVE BANDS 0-43, MAX 1/2 SEC SLOW AL
 548 608 664 693 712 739 766 756 752 748
 735 738 740 730 862 730 690 792 816 850
 749 750 818 774 799 757 737 761 775 800
 783 766 756 743 711 683 658 622 592 575
 581   0   0   0
END
```

APPENDIX C:

Sideline Decay Predictions

```
oh58d IDL LITE    0FT   0KTS
REFERENCE SLNT  250FT   0KTS   59DEGF  70PCTRH 29.92IN.HG
AVGN  40
ALEQ SIDELINE DECAY 100FT-50000FT
 803 783 762 741 720 698 676 654 631 608
 584 559 534 507 480 453 425 397 369 341
 313 285 258 230 201 174 143 111
END

oh58d IGE LITE    2FT   0KTS
REFERENCE SLNT  250FT   0KTS   59DEGF  70PCTRH 29.92IN.HG
AVGN  40
ALEQ SIDELINE DECAY 100FT-50000FT
 901 880 860 839 818 797 775 754 732 709
 686 662 637 611 585 557 529 499 469 437
 406 375 343 312 281 250 217 185
END

oh58d LFO LITE  300FT  40KTS
REFERENCE SLNT  250FT  40KTS   59DEGF  70PCTRH 29.92IN.HG
AVGN 165
ALMX SIDELINE DECAY 100FT-50000FT
 915 894 874 853 832 811 790 769 747 725
 702 679 655 631 605 579 551 522 493 462
 430 398 365 332 298 264 228 192
ASEL SIDELINE DECAY 100FT-50000FT
 973 958 944 929 915 900 885 869 853 837
 821 803 786 767 747 727 705 683 659 634
 609 582 555 528 500 472 443 412
END

oh58d LFO LITE  300FT  70KTS
REFERENCE SLNT  250FT  70KTS   59DEGF  70PCTRH 29.92IN.HG
AVGN 218
ALMX SIDELINE DECAY 100FT-50000FT
 927 907 887 866 845 824 803 782 760 738
 715 692 668 644 619 593 565 537 509 479
 448 417 385 352 319 285 249 212
ASEL SIDELINE DECAY 100FT-50000FT
 968 953 939 924 910 895 880 864 848 832
 816 799 781 762 743 723 702 680 657 633
 608 583 557 531 503 475 445 414
END

oh58d LFO LITE  300FT 100KTS
REFERENCE SLNT  250FT 100KTS   59DEGF  70PCTRH 29.92IN.HG
AVGN 232
ALMX SIDELINE DECAY 100FT-50000FT
 952 932 912 891 871 850 829 807 786 764
 742 719 696 672 647 621 595 568 539 510
 480 449 418 386 353 319 284 247
ASEL SIDELINE DECAY 100FT-50000FT
 984 969 955 940 926 911 896 881 865 849
 833 816 799 781 762 742 722 701 678 655
 631 606 581 555 528 500 471 440
END
```

oh58d LFO LITE 300FT 120KTS
REFERENCE SLNT 250FT 120KTS 59DEGF 70PCTRH 29.92IN.HG
AVGN 170
ALMX SIDELINE DECAY 100FT-50000FT
959 938 918 897 877 856 835 813 792 770
748 725 701 677 652 627 600 572 544 514
483 452 419 386 353 318 283 245
ASEL SIDELINE DECAY 100FT-50000FT
989 974 960 945 931 916 901 886 870 854
838 821 803 785 767 747 726 704 682 658
633 608 581 555 527 498 469 437
END

oh58d LFO LITE 1000FT 70KTS
REFERENCE SLNT 250FT 70KTS 59DEGF 70PCTRH 29.92IN.HG
AVGN 77
ALMX SIDELINE DECAY 100FT-50000FT
949 928 908 887 867 846 825 804 783 761
739 717 694 670 646 621 596 570 542 515
486 457 426 396 364 332 299 264
ASEL SIDELINE DECAY 100FT-50000FT
991 977 963 948 934 919 904 889 874 858
842 825 809 791 773 754 735 714 693 671
649 625 601 577 551 525 497 469
END

oh58d LFO LITE 1000FT 100KTS
REFERENCE SLNT 250FT 100KTS 59DEGF 70PCTRH 29.92IN.HG
AVGN 74
ALMX SIDELINE DECAY 100FT-50000FT
942 922 902 881 860 839 818 797 775 753
730 707 683 658 633 607 580 552 523 493
462 430 397 363 328 292 255 216
ASEL SIDELINE DECAY 100FT-50000FT
984 970 955 940 926 911 896 880 864 848
831 814 797 778 759 739 718 696 673 649
624 597 571 543 514 484 452 419
END

oh58d LND LITE 300FT 40KTS
REFERENCE SLNT 250FT 40KTS 59DEGF 70PCTRH 29.92IN.HG
AVGN 59
ALMX SIDELINE DECAY 100FT-50000FT
960 940 919 898 878 857 835 814 792 770
747 723 699 674 647 620 591 561 530 497
463 429 394 360 326 292 257 223
ASEL SIDELINE DECAY 100FT-50000FT
10161002 987 972 958 943 927 912 896 880
863 845 827 808 788 766 744 720 694 667
640 611 582 554 526 498 469 441
END

oh58d OGE LITE 50FT 0KTS
REFERENCE SLNT 250FT 0KTS 59DEGF 70PCTRH 29.92IN.HG
AVGN 40

```
ALEQ SIDELINE DECAY 100FT-50000FT
 971 951 931 910 889 868 847 825 803 781
 758 734 709 684 657 629 600 568 535 500
 463 425 386 348 311 275 240 206
END

oh58d TKF LITE  300FT  40KTS
REFERENCE SLNT  250FT  40KTS  59DEGF  70PCTRH 29.92IN.HG
AVGN  65
ALMX SIDELINE DECAY 100FT-50000FT
 943 923 902 882 861 840 819 797 775 753
 730 706 682 657 630 603 574 543 511 478
 443 407 371 336 301 267 233 198
ASEL SIDELINE DECAY 100FT-50000FT
 982 968 953 938 924 909 893 878 862 846
 829 811 793 774 753 732 709 684 658 630
 601 572 542 513 484 456 427 399
END
```

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ATTN: CEMP-ZA
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